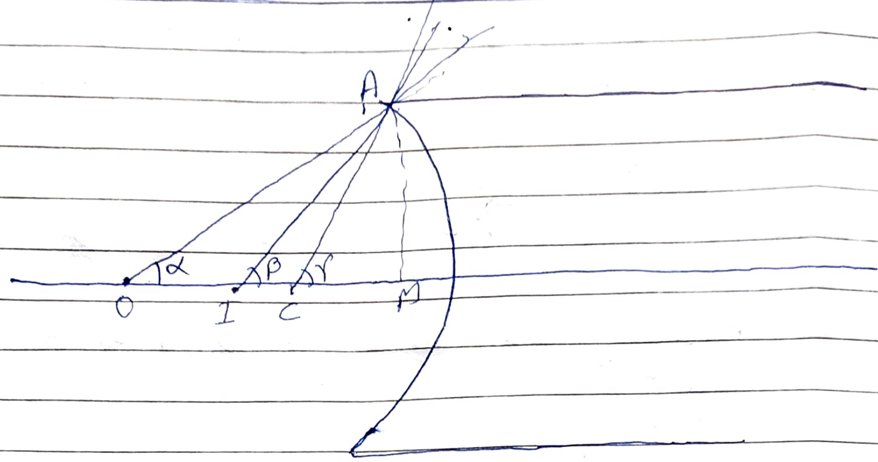
Refraction at a concave surface



From diagram

ΔAOC

$$\gamma = \alpha + i$$

$$i = \gamma - \alpha \quad \text{--- (i)}$$

ΔACI

$$\gamma = r + \beta$$

$$r = \gamma - \beta \quad \text{--- (ii)}$$

$$\tan \alpha = \frac{AM}{OM}$$

$$\tan \beta = \frac{AM}{MI}$$

$$\tan \gamma = \frac{AM}{MC}$$

From first order theory

$\tan\alpha \simeq \alpha$, $\tan\beta \simeq \beta$ and $\tan\gamma \simeq \gamma$

$\alpha = \frac{AM}{OM}$, $\beta = \frac{AM}{MI}$

$\gamma = \frac{AM}{MC}$

Putting the value of α, β and γ in eqⁿ (i) and (ii)

$$i = \frac{AM}{MC} - \frac{AM}{OM} \quad \text{— (iii)}$$

$$r = \frac{AM}{MC} - \frac{AM}{MI} \quad \text{— (iv)}$$

By using Snell's law

$$_1\mu_2 = \frac{\sin i}{\sin r}$$

$$\frac{\mu_2}{\mu_1} = \frac{\sin i}{\sin r}$$

$$\mu_2 r = \mu_1 i$$

$$\mu_2\left(\frac{AM}{MC} - \frac{AM}{MI}\right) = \mu_1\left(\frac{AM}{MC} - \frac{AM}{OM}\right)$$

$$\mu_2\left(\frac{1}{MC} - \frac{1}{MI}\right) = \mu_1\left(\frac{1}{MC} - \frac{1}{OM}\right)$$

$$\mu_2\left(\frac{1}{-R} - \frac{1}{(-v)}\right) = \mu_1\left(\frac{1}{-R} - \frac{1}{(-u)}\right)$$

$$\mu_2\left(-\frac{1}{R} + \frac{1}{v}\right) = \mu_1\left[\frac{1}{-R} + \frac{1}{u}\right)$$

$$-\frac{\mu_2}{R} + \frac{\mu_2}{v} = -\frac{\mu_1}{R} + \frac{\mu_1}{u}$$

$$-\frac{\mu_1}{u} + \frac{\mu_2}{V} = -\frac{\mu_1}{R} + \frac{\mu_2}{R}$$

$$\frac{\mu_1}{u} - \frac{\mu_2}{v} = \frac{\mu_1}{R} - \frac{\mu_2}{R}$$

$$\boxed{\frac{\mu_1}{u} - \frac{\mu_2}{V} = \frac{\mu_1 - \mu_2}{R}}$$

— x —